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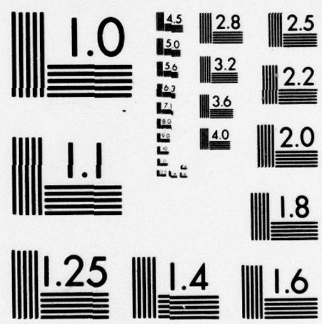

MICROCOPY RESOLUTION TEST CHART

ESD-TR-79-115

AIR FORCE TACTICAL C^3I SYSTEMS

Donald B. Brick

December 1978

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Prepared for

DEPUTY FOR DEVELOPMENT PLANS
ELECTRONIC SYSTEMS DIVISION
HANSCOM AIR FORCE BASE, MA 01731

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TACTICAL COMMAND CENTERS	TACTICAL SYSTEM INTEROPERABILITY
TACTICAL COMMAND CONTROL	TACTICAL TECHNOLOGY

20. ABSTRACT (*Continue on reverse side if necessary and identify by block number*)

An overview of Air Force Tactical C^3I Systems and their functions is provided. The inter-relationships with other systems with which these systems must inter-operate are pointed out. The rationale, developed in the joint tactical architectural effort of the Electronic Systems Divison of AFSC and the Tactical Air Forces Interoperability Group, to choose development paths to achieve future operational goals is described. Major problems encountered in the

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20. ABSTRACT (concluded)

acquisition and operation of tactical C^3 systems and a list, and in some cases a description, of promising technology areas aimed at alleviating these problems are discussed. Finally, the impacts of technology and architecture development on future tactical C^3 system developments are related.

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SECTION I

DEFINITION OF C^3I

The Joint Chiefs of Staff Publication 2 (JCS Pub 2) contained the following definition of the Command, Control, and Communications[1] (C^3) Process:

> "A composite of equipment, skills, and techniques which, while not an instrument of combat, is capable of performing the clearly defined function of enabling a commander to exercise continuous control of his forces and weapons in all situations by providing him with the information needed to make operational decisions and the means to disseminate them."

The generic functions of C^3 are to:

Acquire Information (via Sensors, Collectors, Information Sources)

Evaluate and Process The Information

Make Decisions, Evaluate Alternative Courses of Action

Provide these Decisions/Commands to the Forces

The process is shown in Figure 1[2], where the differentiation between information about our own forces and that acquired about enemy forces (i.e. intelligence information) has been introduced. Using this reasoning, "I" for "Intelligence" has of late been added to C^3.

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[1] Deleted from recent editions of JCS Pub 2 but useful for our purposes here.

[2] Kindly provided by Dr. John Burgess of RADC

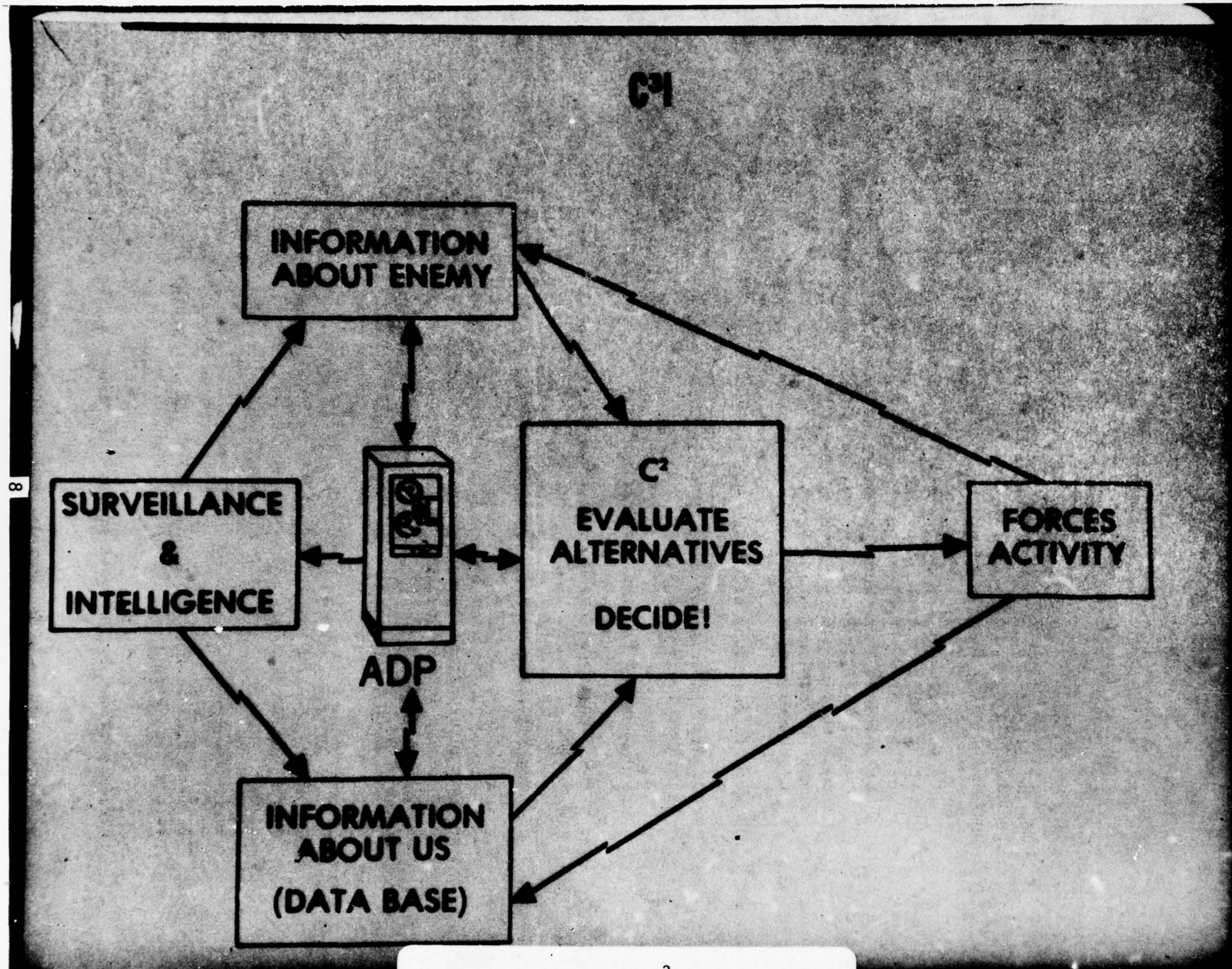
C³I
INFORMATION ABOUT ENEMY
SURVEILLANCE & INTELLIGENCE
ADP
C²
EVALUATE ALTERNATIVES
DECIDE!
FORCES ACTIVITY
INFORMATION ABOUT US
(DATA BASE)

FIG. 1 C^3I

SECTION II

TACTICAL AIR FORCES C^3I

The function of the Tactical Air Force (TAF) C^3I System is to perform all the elements of command and control required by the TAF, from force direction to logistics support. These include:

- Force Management
- Air Battle Management
- Air Surveillance
- Airspace Control
- Aircraft Identification
- Ground Target Surveillance
- Strike Control
- Electronic Warfare
- Communications
- Information Gathering
- Sensor Operation, Control and Management
- Intelligence Collection, Interpretation, and Dissemination
- Logistic Support

It consists of equipment, people, and organizations operating Command Facilities, Data Processing Systems, Communication Systems, Collectors and Sensors. Although only a part of the deployed TAF C^3I Systems[3], the deployable Tactical Air Control System (TACS) pictured in Figure 2 is the heart of that system. It consists of seven components. The highest level is the Tactical Air Control Center (TACC) located at the Air Force Component Command Post (AFCCP. The Control and Reporting Center (CRC), the Control and Reporting Post (CRP), The Forward Air Control Post (FACP), the Tactical Air Control Party (TACP) the Direct Air Support Center (DASC), and the Tactical Air Base (TAB) comprise the remaining command and control centers.

Figure 3 contains a System Description of the 407L version of the TACS. It lists the functions of each component, the communications interconnecting them, and typical distance relationships between interconnected centers (in miles). Although the physical configurations of the components are not accurate, the functional

[3] The several fixed (or static) TACS systems are similarly organized with corresponding components often bearing different names for a variety of local reasons.

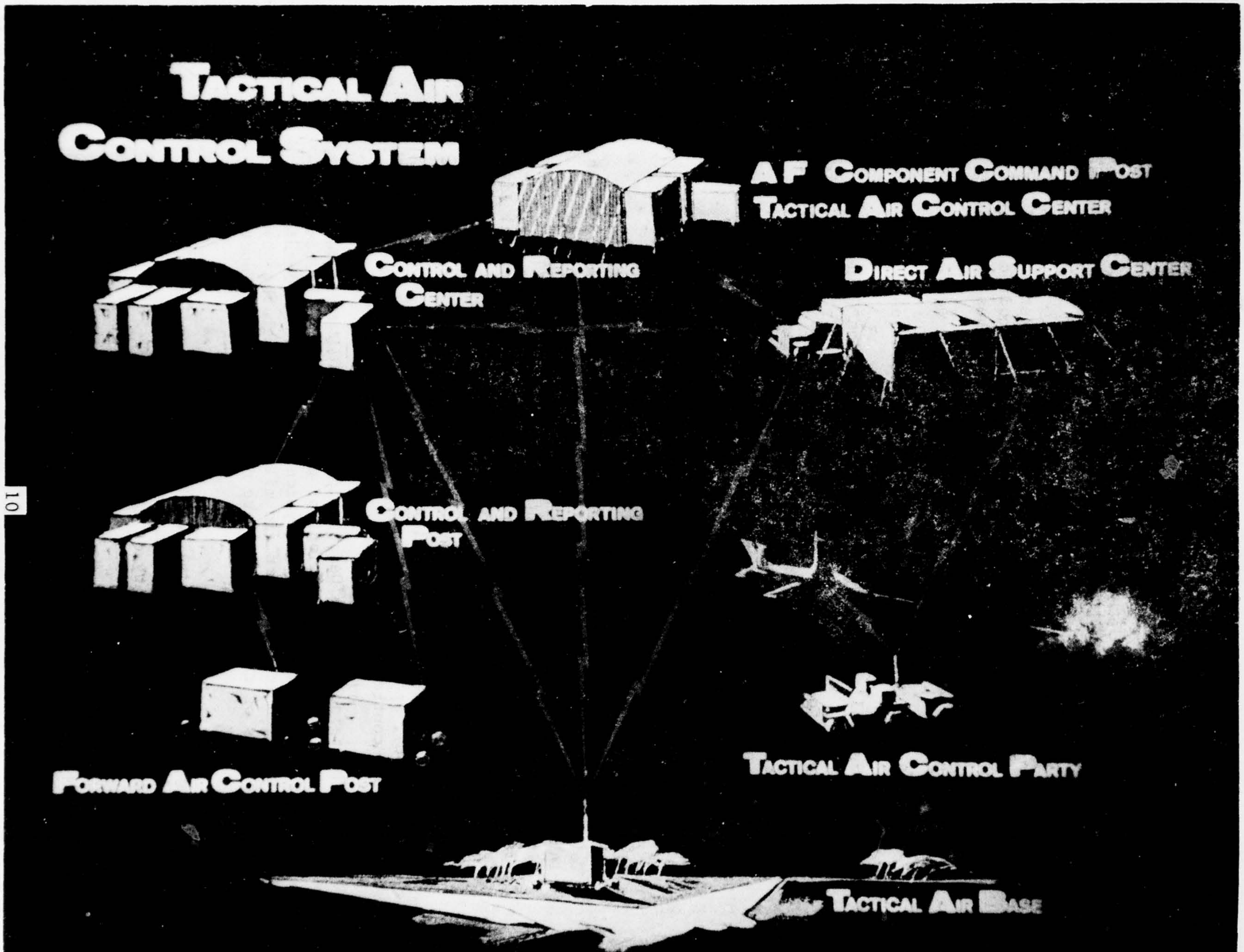

FIG. 2 TACTICAL AIR CONTROL SYSTEM

descriptions are concise and comprehensive.

A number of steps to upgrade and modernize the now 7-plus year old 407L system are in progress under the 485L TACS Improvements (TACSI) program and the TACC Automation (TACC Auto) program. These are shown in Figure 4 and consist of the following major upgrades:

(1) Tactical Air Control System/Tactical Air Defense System (TACS/TADS). This program resulted in the development of the Message Processing Center (MPC) to provide Air Force, Army, and Navy data-link interoperability.

(2) CRC Improvements including a radar simulator (called the System Trainer and Exercise Module - STEM), Automatic Radar Tracking (ART), and Enroute Air Traffic Routing (EATR).

(3) The capability to remote the radars via microwave radio from their shelters (the FACP's, CRP's, CRC's) to reduce their vulnerability.

(4) Improved communications for the Forward Air Controller (FAC), the AN/PRC104.

(5) An Electrical Equipment Repair Shelter (S-530A/G) to ease electrical equipment maintenance in the field and

(6) A program aimed at Automating the presently-manual TACC (called TACC Automation or TACC Auto), shown in more detail in Figure 5.

In addition to providing the automated data-base, data-base management, and interactive on-line capabilities (including some decision aids and large and small video screens) required to automate the operation of the Current Operations and Current Plans sections of the TACC; TACC Auto also provides communication processing for digital data links, which previously were not provided, to the DASC's, Air Lift Control Elements or ALCE's (C^3 centers for airlift elements), and Tactical Air Bases (called Tactical Unit Operations Centers), as well as the Mobile Data Centers (MDC's) for the remote terminals of those links. The MDC's provide display, data entry, and modest data-processing and data-base management capabilities for the DASC's, ALCE's, and TUOC's.

A very important addition to the Tactical Air Force C^3I system is the E-3A Airborne Warning and Control System, the AWACS, shown in

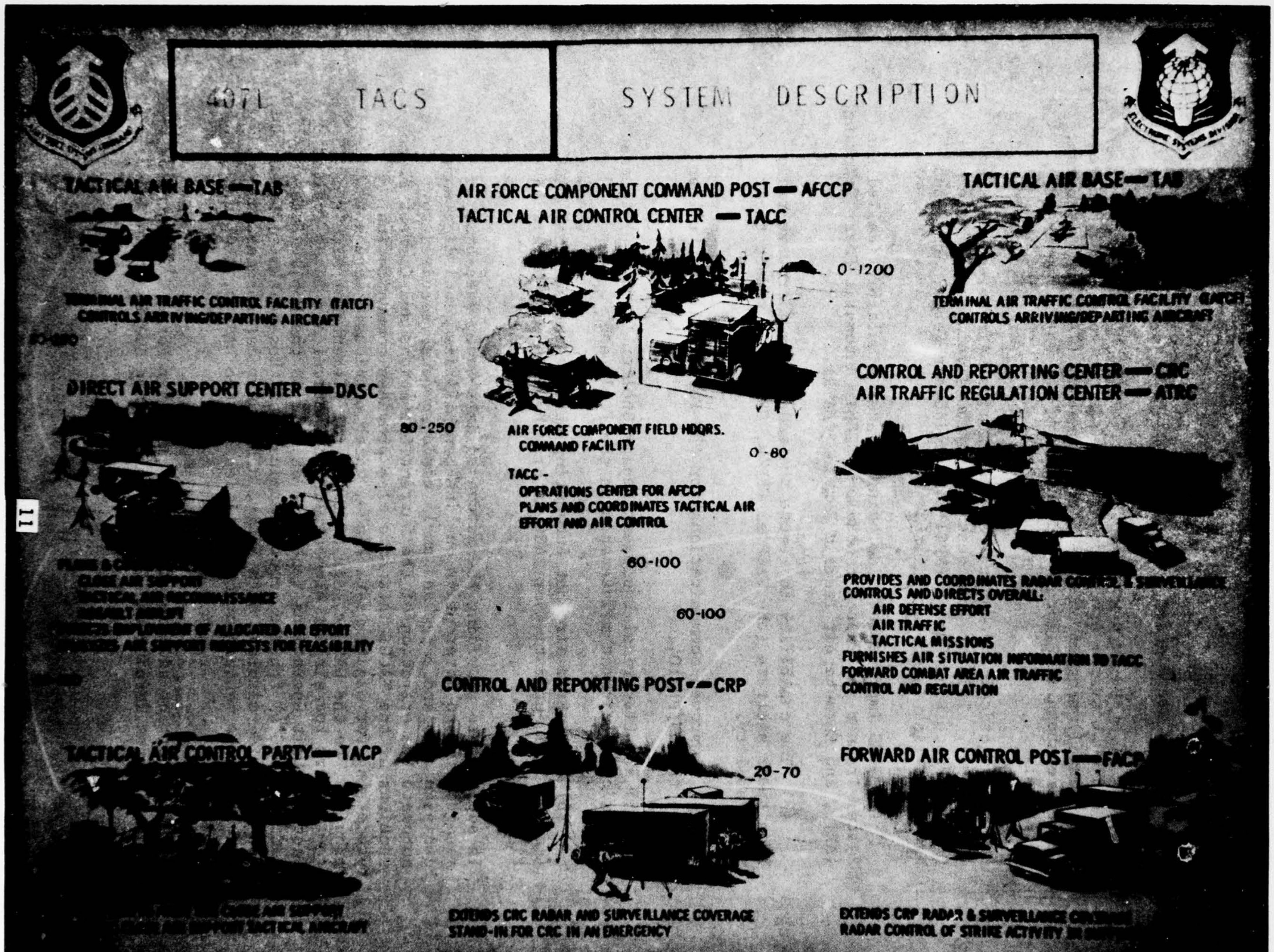

FIG. 3 407L TACS

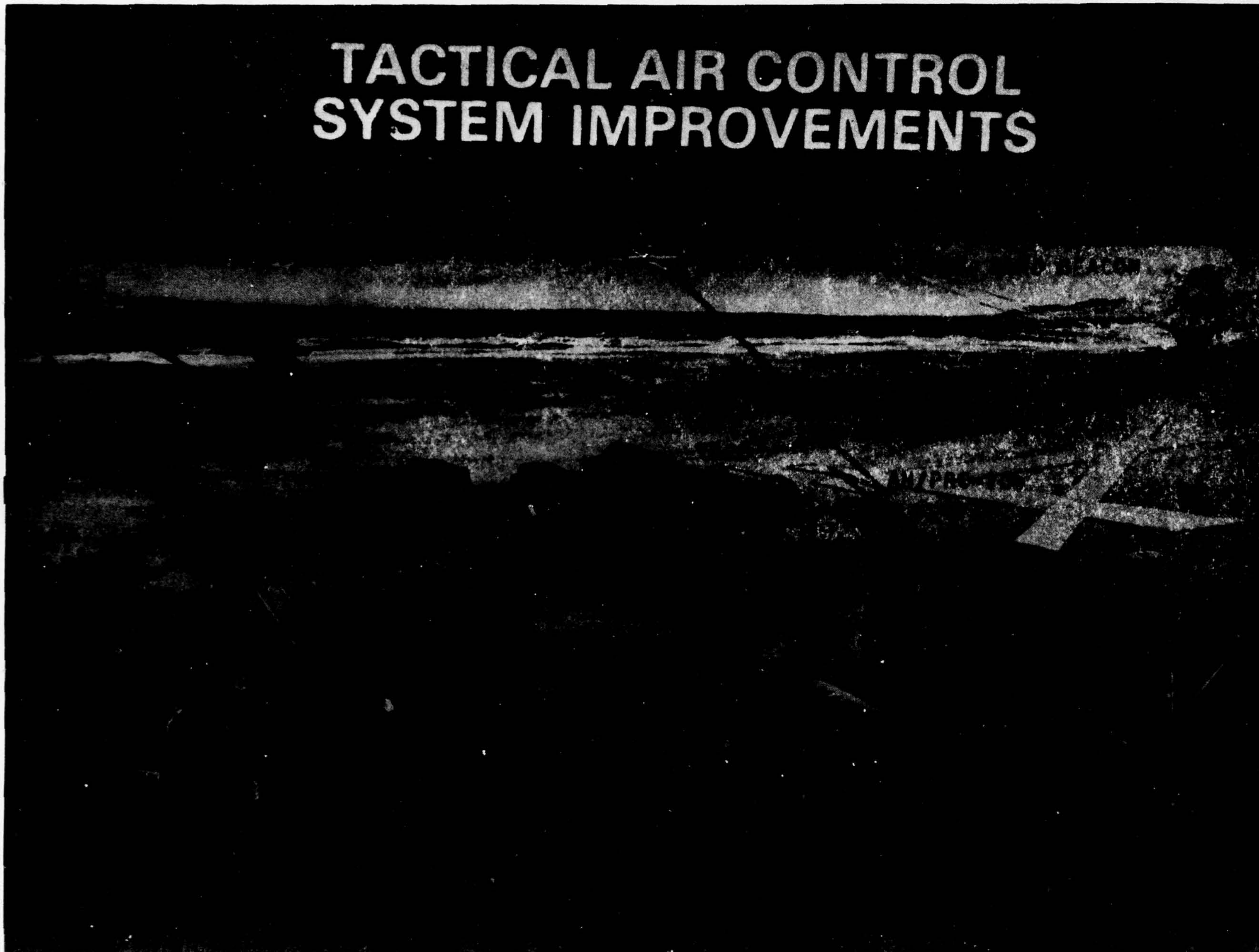

FIG. 4 TACTICAL AIR CONTROL SYSTEM IMPROVEMENT

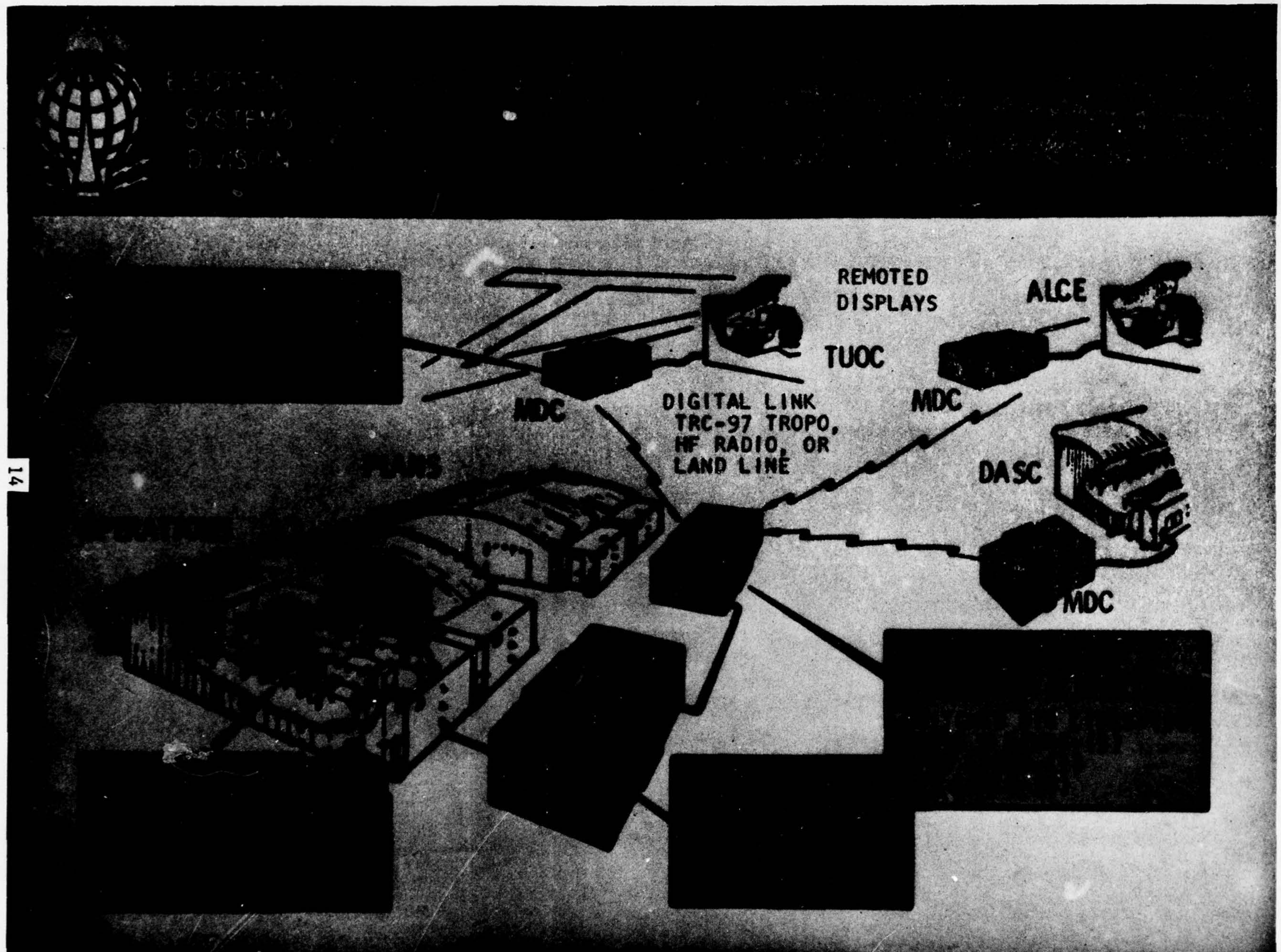

FIG. 5 TACC AUTOMATION ELEMENTS

Figure 6 which not only provides low altitude, over-the-FEBA radar coverage with a very modern look-down radar system but also provides an airborne C^3 Center, a platform for air-to-air and air-ground-air communications, and a relay platform, Figure 7.

To date the major means of air-to-air and air-ground/ground-air communication has been VHF and/or UHF voice. Programs are presently underway to suitably reduce the countermeasures vulnerability and increase the security of these voice links. In the next several years, the services will introduce the Joint Tactical Information Distribution System, Figure 8, a time division multiple access (TDMA) data and voice communication system which will provide the capability to net numbers of voice and data subscribers together so that any one can put selected data on the net and any authorized user can choose to receive the data he wants and needs. All of this is done with the capability to operate in secure and jam resistant modes. JTIDS terminals are under development for large aircraft or ground installations, fighter and other small aircraft installation, ground interfacing to other classes of data links, and manpack/jeep mounted applications.

Ground/ground communications is a major cost-driving item of the TAF C^3, as may be appreciated from the communications linking just one subset of the TACS, the rear area TACS, Figure 9. Most of this equipment is scheduled to be replaced in the 1980's by improved digital equipment being developed under the Tri-Service Tactical Communications (TRI-TAC) program whose objective is to achieve tri-service commonality of next-generation tactical communication equipment.

Then, there are the intelligence collection and interpretation assets of the Tactical Air Force, some of which are pictured in Figure 10. In the foreground are the Imagery Interpretation (II) and Automated Combat Information Center (ACIC) or Display Control/ Storage and Retrieval (DC/SR) portion of the Tactical Information Processing and Interpretation (TIPI) program, now to be co-located with the TACC.

FIG. 6 E-3A CORE CONFIGURATION

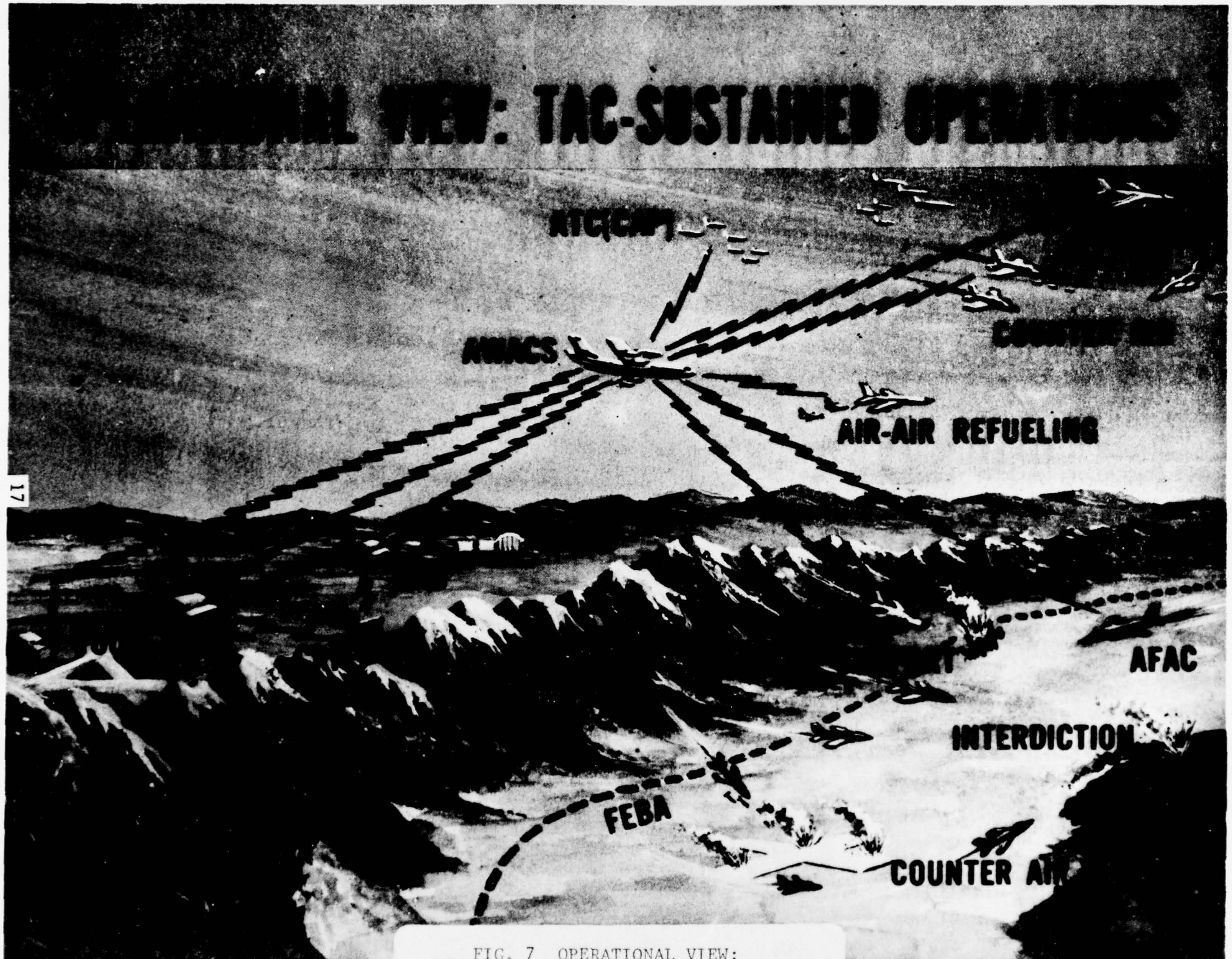

FIG. 7 OPERATIONAL VIEW:
TAC-SUSTAINED OPERATIONS

FIG. 8 JTIDS

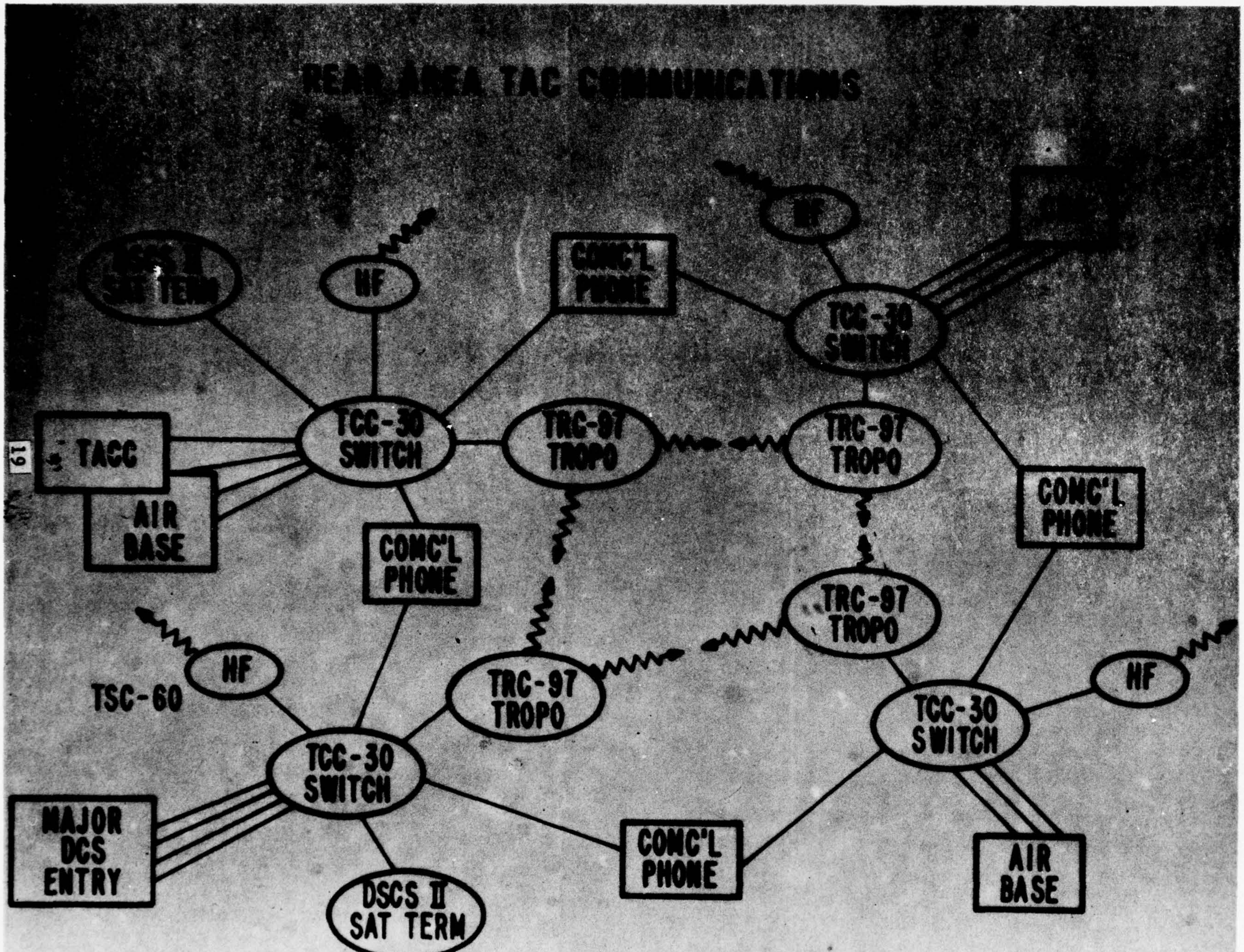

FIG. 9 REAR AREA TAC COMMUNICATIONS

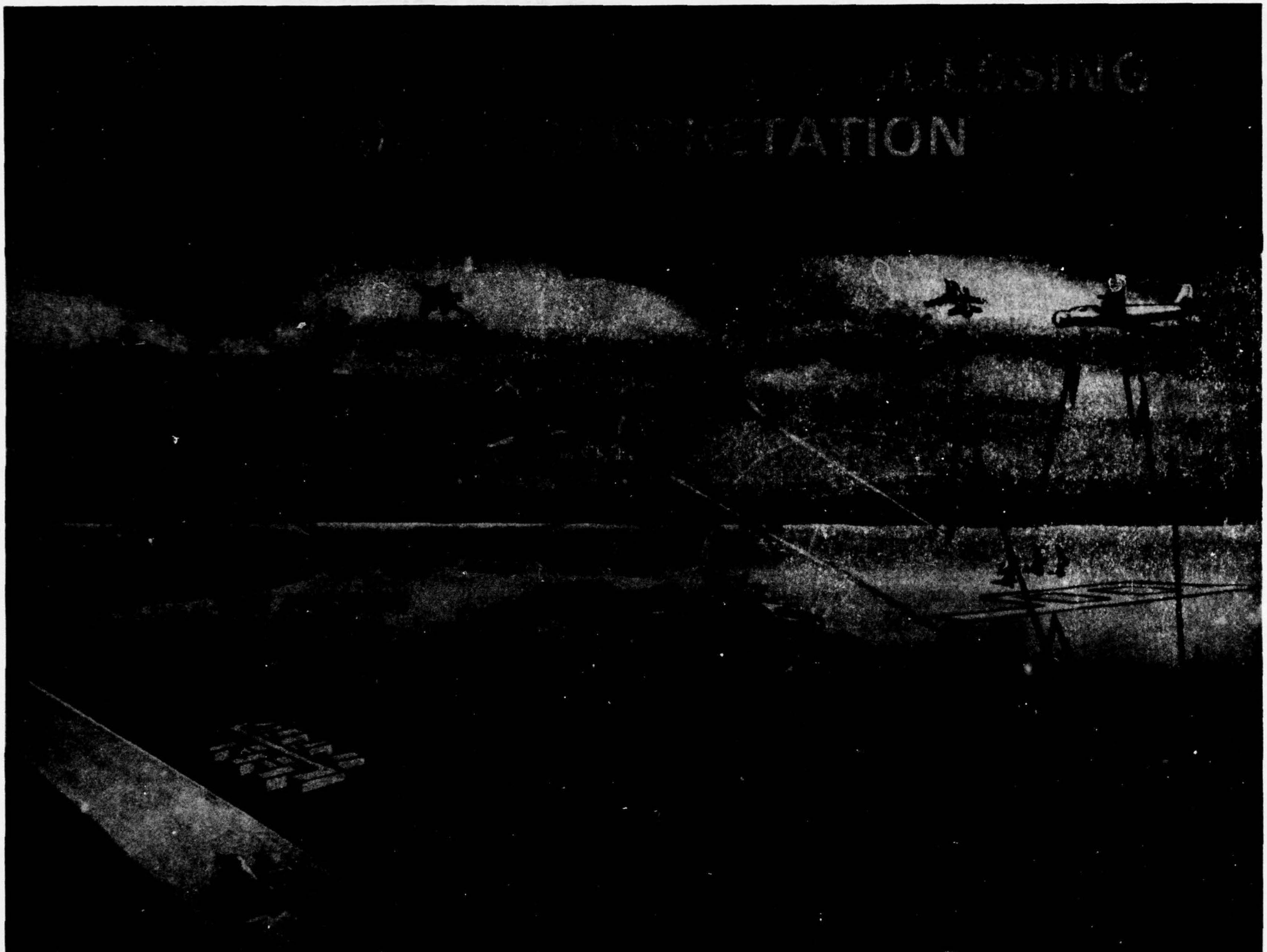

FIG. 10 TACTICAL INFORMATION PROCESSING AND INTERPRETATION

SECTION III

INTEROPERABILITY AND ARCHITECTURE

It was stated earlier that the Tactical Air Control System (TACS) is the heart of the deployed TAF C^3 System, i.e. the TACS is imbedded in the TAF C^3 system. The TAF C^3 system is in turn imbedded in the overall tactical environment. One of the major problems encountered in fielding C^3I systems is that more often than not many of the interoperability requirements of that system have not been foreseen and planned in advance. For example, in the 485L TACS Improvement Program, the TACS/TADS effort was a post-operative program to correct the interoperability deficiencies between the TACS and corresponding Army, Navy, and Marine C^3I elements with which the TACS would have to operate in a combined exercise. It was seen that a Message Processing Center (MPC) development resulted from this effort, basically for TADIL A/ TADIL B data-link interfacing.

This problem is very common, not primarily because of short-comings of the individual system developer, but because he does not have an overall architecture and architectural plan to indicate to him in what environment his system will be placed when it goes operational and thereafter. This may seem to be a naive requirement until one realizes that the environment referred to is a very, very complex, dynamic and basically unstructured one with parallel developments coming on-stream from all-quarters in a quasi-random set of timing relationships. The overall system architecture responds to the peculiar needs, vulnerabilities, hot buttons, and pressures of the moment. Even if static, it would not be simple. An example frequently shown is the so-called "worms" chart of Figure 11. This chart emphasizes that the deployable TACS will have to be interoperable with the NATO system (Allied Systems) as well as U. S. systems.

To alleviate this problem a number of high level architectural efforts have been initiated. The one relevant to Air Force Tactical C^3I is the joint effort of The Tactical Air Forces Interoperability Group and the Deputy for Development Plans, Electronic Systems Division, Air Force Systems Command called the Tactical Air Forces Integrated Information System (TAFIIS) Master Plan.

In essence, it identifies the functions (missions) of each Air Force Tactical C^3 node and the information requirements and output

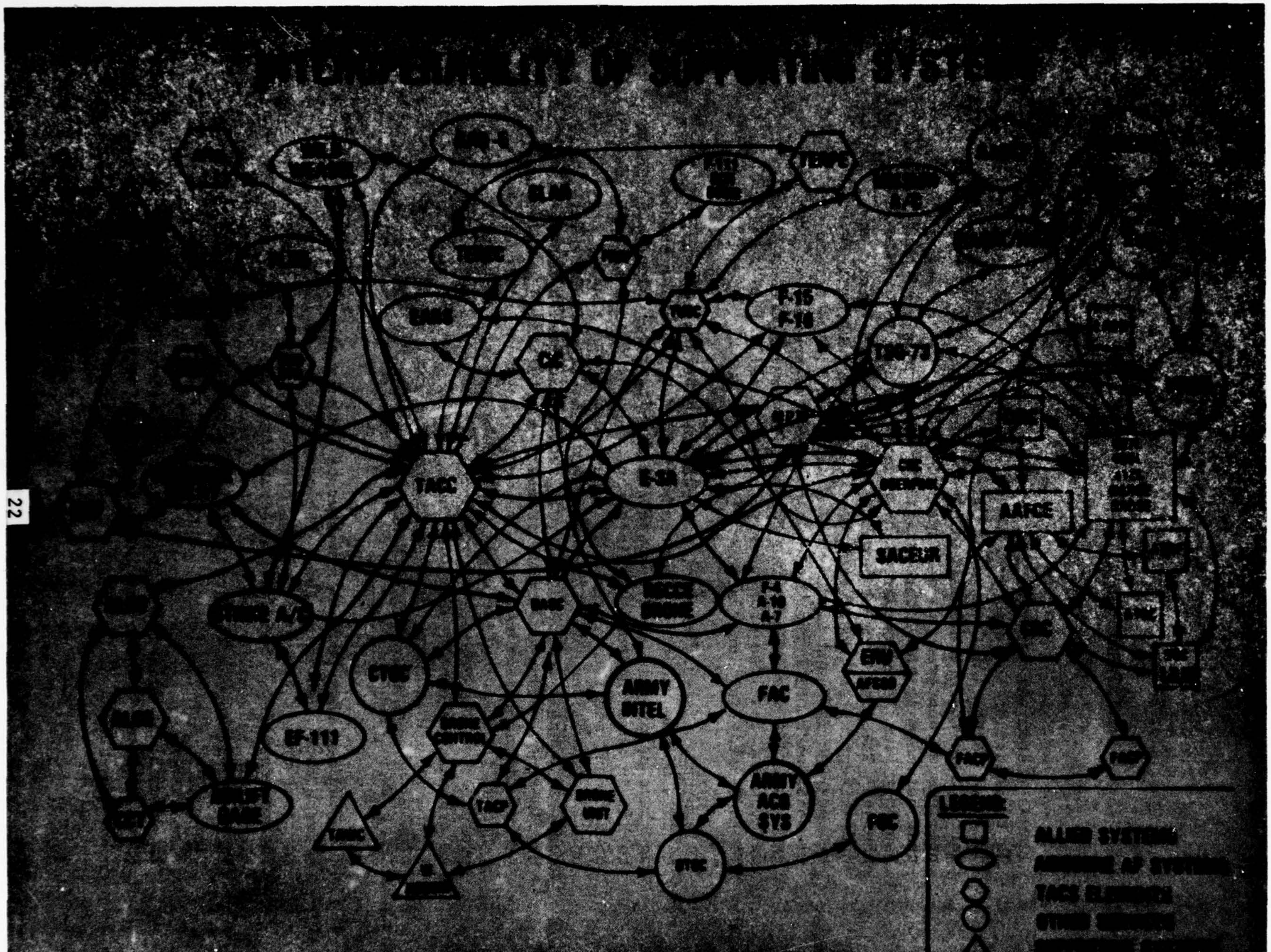

FIG. 11 INTEROPERABILITY OF SUPPORTING SYSTEMS

of each, from whom and to whom, and the initial timing requirements on a mission-by-mission basis. This process not only identifies the interoperability requirements for each node, as a guide (or roadmap) to the system designer but also serves to identify capability short falls. In this way the process leads to both equipment and architectural development goals.

The process produces a roadmap on a mission-by-mission or function-by-function basis. For example, consider the mission tactical airspace control: The process leads to a set of user requirements or goals, e.g. adequate control capability, non-real time reaction, en-route accurate target update, mission control flexibility, timely accurate threat warning, and improved manpower utilization; alternative system concepts are assembled, e.g. I, FACP improvement and data link, II, Increase automation in existing facilities, III, new mobile air-space control facility, IV, transfer mission control to strike aircraft; analysis is performed for major considerations such as research and/or developments needed by when and at what cost, system trade-offs, interoperability considerations, user acceptance and preference, etc; and from these considerations and others the various program options that result are analyzed and compared analytically to arrive at a program definition. In the TAFIIS Master Plan, the output of this process is expressed in a set of roadmaps, as shown in Figure 12, where the various alternative development paths considered are shown along with the resulting end points vis-a-vis the mission goal. The roadmap shows starting points in terms of existing programs, R&D and acquisitions feeding into the program; decision points at the various system configuration choices; developments that either have to be supported or exploited as inputs to the program and when each must be done with respect to the critical decision points on the roadmap. It also indicates what facilities are needed and when.

These roadmaps serve as a guide to the planners and budgeteers since it spells out the critical elements of a program, the short falls of not undertaking a particular development or taking alternative paths, and the R&D that has to be undertaken or transferred and when.

This process not only indicates mission/systemwide short falls but also indicates needed capabilities, technology, and acquisition improvements. These are the subject of the following sections.

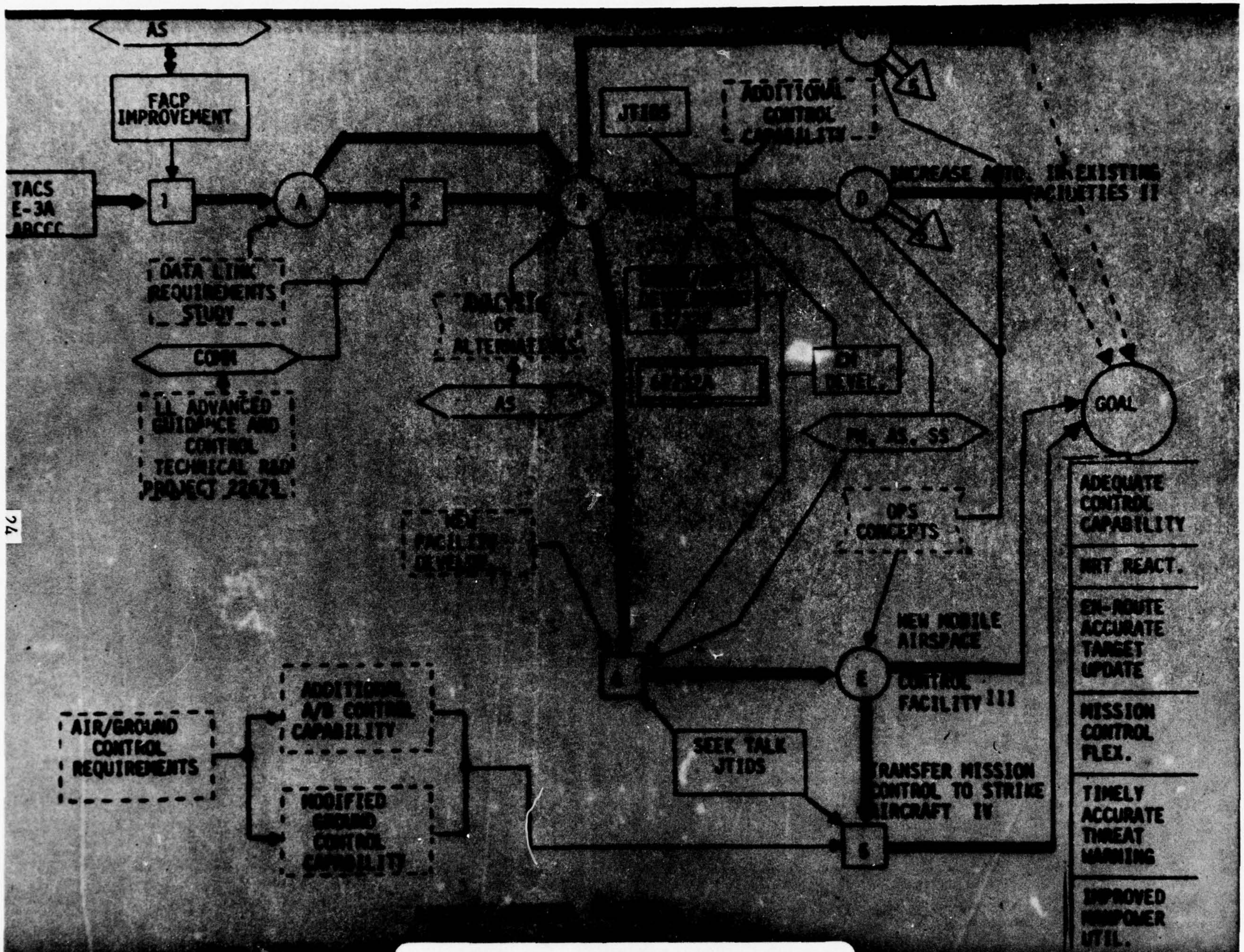

FIG. 12 AIRSPACE CONTROL ROADMAPS

SECTION IV

MAJOR C^3I ACQUISITION & TECHNOLOGY PROBLEMS

The C^3I system user's main interests are in obtaining C^3I systems that are responsive to and fulfill his urgent and high-priority needs in a timely manner; that he can introduce or fit into his operations with a minimum of dislocation, stress, strain and retraining; that will improve his operational performance, increase, if possible, his operational capabilities, and correct operational deficiencies and short falls. It is also desirable that they increase efficiency of operation; satisfy "...ility" requirements (see Figure 13); are sufficiently flexible, adaptable to future threats, needs and environments; and reduce or, at least don't increase manpower requirements. Responsiveness, timeliness, cost/effectiveness, and ease of melding into the existing system are key to the user.

Some of the major problems that the C^3I developer/acquirer/user community faces in responding to the tactical user's needs are:

(1) For a variety of reasons, C^3I systems have been plagued by a history of development overruns in time and cost.

(2) When delivered, they often are outdated and/or are inflexible, i.e. unable to adapt and respond to changing requirements, environments, and users.

(3) As described earlier, piecemeal system development coupled with the lack of controlling architectures often lead to interoperability problems. In addition, the evolutionary nature of C^3I systems implementation imposes the requirement for backward compatibility added to those of interoperability and future adaptability.

(4) Although computers are sold on the basis of manpower savings, documented cases of such savings are few and far between. Manpower savings are usually traded-off in favor of additional capabilities. This factor complicates the continual DoD requirements to reduce manpower and make each remaining man more efficient.

(5) Budgetary constraints dictate that improved reliability, easier maintainability, and lower life cycle costs be achieved in addition to the aforementioned constraints.

(6) The electronic and physical countermeasure threats to

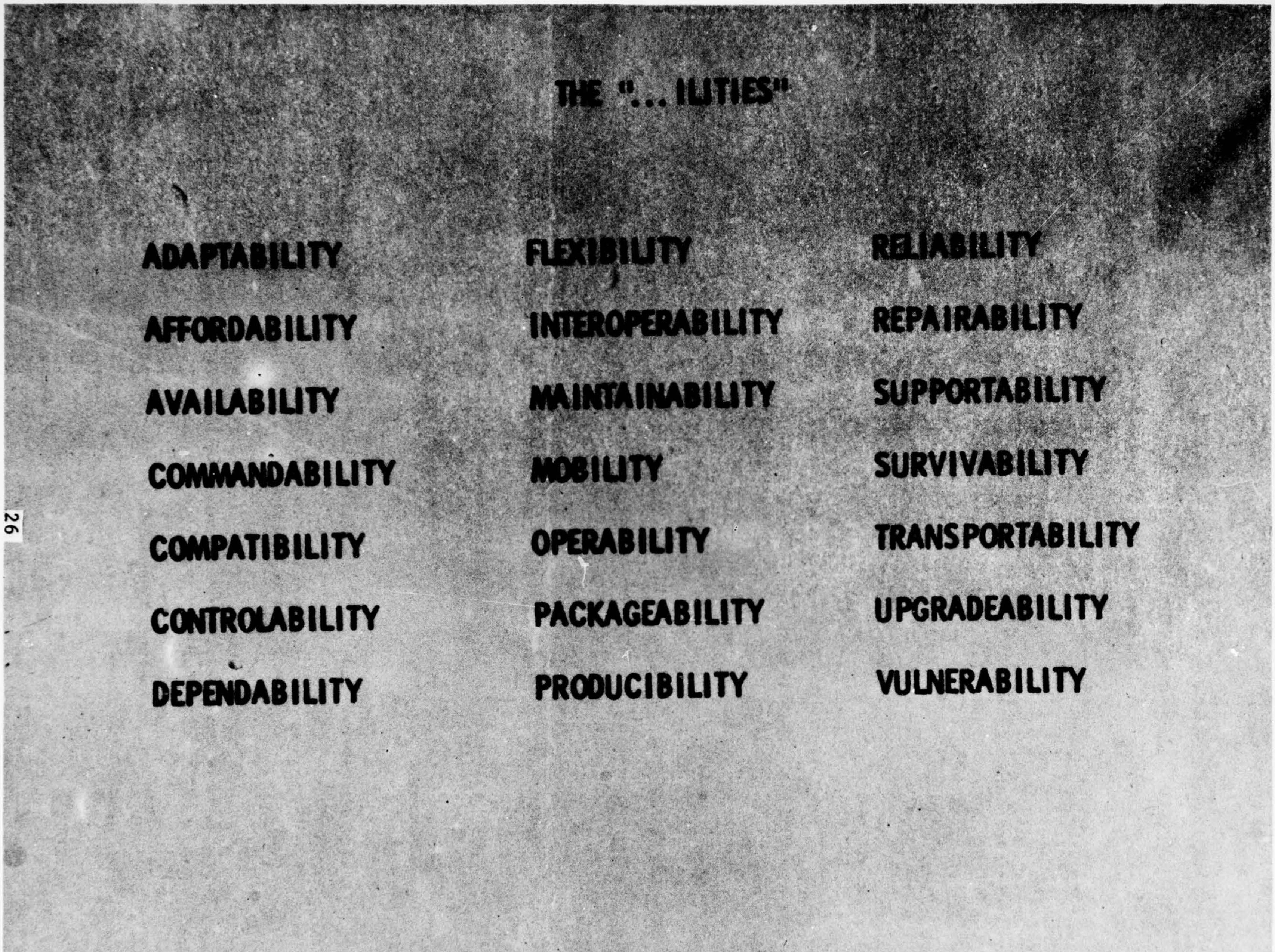

FIG. 13 THE "... ILITIES"

C^3 systems are increasing at an alarming rate. Resistance to these threats must now be upgraded to a principal requirement to be kept continuously at the forefront of system design and retrofit efforts.

(7) Both communication and computer security must be regarded in a similar vein. Our potential adversaries are becoming ever-more sophisticated.

(8) Positive, reliable, and robust target identification (in particular, aircraft identification) has proven to be a very high-priority problem that has stubbornly resisted solution.

(9) Since, no matter how resistant a C^3I system may be, at some level it will be rendered ineffective or of reduced-effectiveness. It is important to adopt the additional design requirement of graceful degradability and the capability to recover or reconfigure fully or partially.

(10) Communications is the life line of C^3I. Most present communications systems are extremely susceptible to the harsh environments they are likely to face in present and future operations (whether induced by the enemy, ourselves, or nature).

(11) The cost to buy equivalent electronic capability is decreasing radically. Despite this, the cost of installing equipment is increasing just as radically. This is especially true in the case of aircraft retrofits, the cost often being many multiples of the equipment cost. Economic prudence dictates that these be brought more into balance.

(12) Intelligence collection, correlation, and interpretation has advanced rapidly in step with computer advances. However, the problems of processing data sufficiently rapidly, fusing it with operational information, sanitizing it, and distributing it in a form so that it is useful to the commander in the field requires attention.

(13) Quantitative measures of effectiveness are needed to evaluate the so-called force-effectiveness multiplier factor of C^3I (i.e., What is the "quantitative" increase (or decrease) in effectiveness of U. S. forces in absolute or comparative terms, caused by the addition, deletion or replacement of a particular C^3I system) to assist in budget and acquisition decisions.

(14) Improved quantitative methods are also needed in the related areas of system performance measures including analytic

methods, simulations, test and exercise measures. Test beds are needed for system design and development purposes as well as for operational evaluation.

(15) One of the major areas where improved responsiveness to user needs can be achieved is at the man/machine interface. System designers should work backward, starting with the user's interface needs in the design of decision aids, man/machine coupling, data base design and retrieval. The user must be involved from the beginning.

(16) Present deployable C^3I systems such as the TACS, although nominally mobile, require so major a commitment of airlift capability to move them, their support, and their communications and so long a set up time as to render them moveable but defacto immobile.

(17) The production costs of C^3I systems suffer from their one or few-of-a-kind nature. Efforts are required to utilize, wherever possible, production modules or components in their design.

(18) In a similar vein, the fact that DoD is no longer the driving force in the electronic industry frequently results in second-class treatment and often priority problems.

(19) Software is the major cost and time driver in C^3I systems. Software is usually tailored to specific applications and/or hardware and is subject to redesign and reinvention every time one or both are changed. Transferable and robust packages are needed.

(20) The TAF ground sensors are as vulnerable as communications are in a wartime environment. Their coverage, mobility, survivability, and flexibility are deficient.

SECTION V

C^3I TECHNOLOGY DIRECTIONS

Many promising technology initiatives are being pursued to assist in solving the aforementioned problems as well as to provide new C^3I and mission capabilities. Some of the more promising ones are:

(1) Development of cost-estimation analysis and prediction methods to better understand cost-driving factors so as to better estimate schedule and cost, predict and anticipate cost and time schedule departures in time to apply corrective measures to them.

(2) Software Engineering and Production Improvements; in particular, those efforts aimed at developing software-first system architectures, automatic requirements analysis, iterative software synthesis, automatic programming and automatic program testing, structured programming, natural languages, and micro-programming.

(3) Modular hardware and software approaches - a building block approach to system design via the establishment of module families useful across systems. This could, depending on the pace of technology, result in standard modules.

(4) Distributed processing, distributed data bases and input/output terminals, etc. as a means of dispersing C^3I assets such as C^2 centers, radars, communication nodes to reduce vulnerability.

(5) Related to this is the development of unattended/minimally-attended equipment, in particular unattended radars.

(6) Development of low probability of intercept (LPI) emitters for sensors and communications using such techniques as spread spectrum, pseudo-noise, intermittant, deceptive, disguised, and low-side-lobe transmissions. Included in this class are multi-static radars and sanctuary illuminators also for LPI and deceptive purposes.

(7) Fibre optics technology and application.

(8) Adaptive antenna technology aimed at better spatial radiation control to provide less-vulnerable and more-flexible radar and communications systems.

(9) Techniques to enhance and optimize the man/machine partnership such as artificial intelligence methods including

knowledge-based techniques, natural languages, pattern recognition, decision aids for better matching the data presentation to the operators' needs and man/machine process-modelling techniques to separate what the operator needs from what he would like, and in what format.

(10) Computer security kernel development to extend present multi-level security developments to a wider range of computers and environments, including distributed processors and micro-processors.

(11) Communications netting, redundant and adaptive routing, relaying, packet switching; the objective being less vulnerable, more-survivable and secure, flexible, mobile, and recoverable communications with more channel capacity available to more people. Frequency/code/time division multiple access development work is an integral part of this area.

(12) Continued conversion from analog to digital circuitry in both sensors (e.g. radars) and communications.

(13) Continued support and exploitation of advances in computer technology especially microprocessors; signal processors; source data automation and automated data input/output technology; computer hardware i.e. very high-speed, very large scale integrated circuitry, charge-coupled devices, surface acoustic wave devices, bubble memories, large-screen display technology, etc., and the manufacturing processing technology to manufacture these in large quantities at low cost; and the signal and data processing architectural design efforts aimed at developing ultra-reliable self-testing/healing, ultra-survivable, low-vulnerability systems.

(14) Continued emphasis on the target identification problem; in particular the multi-sensor, multi-site correlation techniques using a variety of target emission characteristics; sensor waveform, bandwidth and frequency characteristics; and noncooperative techniques combined with computer processing for track-history bookkeeping; also cooperative techniques such as Mark XII IFF, and JTIDS.

(15) Future developments in fibre optic buses, VHSI/VLSI circuits, and printed antennas hold promise of reducing the cost of installing C^3I equipment particularly on aircraft.

(16) The intelligence data handling and distribution problem mentioned in the last section is receiving increased emphasis through R&D in data correlation and fusion, multi-source data

base technology, and the aforementioned (in (10)) computer security kernel work. The microprocessor offers promise of major advances in the processing, storage, security protection, and display of intelligence data.

SECTION VI

SOME EXAMPLES OF C^3I TECHNOLOGY OPPORTUNITIES

(1) Netting in the TACS

Figure 14 shows the current TACS with its present communications; the current tropo net indicated by a double line and high-frequency links whose terminals are labelled "HF". A new survivable retrofit could be developed by adding the dashed links with new nodes, indicated by + . Another, more advanced version is shown in Figure 15, where a multiplicity of radar types are interconnected including mono-static, multi-static, airborne, ground and mobile radars as nodes; some equipped with sophisticated aircraft ID techniques and all equipped with automatic radar track initiators/processors and track correlators so that only one version of a track is shipped around the network. With a distributed mesh such as this, the C^2 facilities can be redistributed or dispersed as generalized operations facilities capable of sharing their duties or taking over for each other in case of failure.

A natural adjunct to such a system would be a highly-mobile combined radar/communications equipment as shown in Figure 16. The concept is a circular phased-array radar that would pop-up, perform a limited number of search scans, pop-down, and move on. The data communication would be performed by communication beams using the same antenna and transmitter. This could be accomplished by searching-out SPI monitor signals from communication partners, rapidly locking-on, and communicating in short bursts. The phased array gives an adaptive antenna nulling capability as well. LPI and cover would be prime motivators here.

(2) Modular C^3 Flexible Intraconnect Concept

As a step towards equipment modularity and communications standardization, the flexible intraconnect/modular C^3 concept is being developed for C^3I system use by RADC/MITRE/ESD, Figure 17. The concept is to develop a set of interfaces for each module, so that all modules, as shown, in a C^3I center would communicate via one or more standard routines over the bus. Thus, any module of one type would "look like" any other module of the same type. Also, additional modules could be added via bus interface units and the center could grow, shrink, or be reconfigured. This would lead to a standardization so that common modules could be used as building-blocks across a variety of centers. Except for

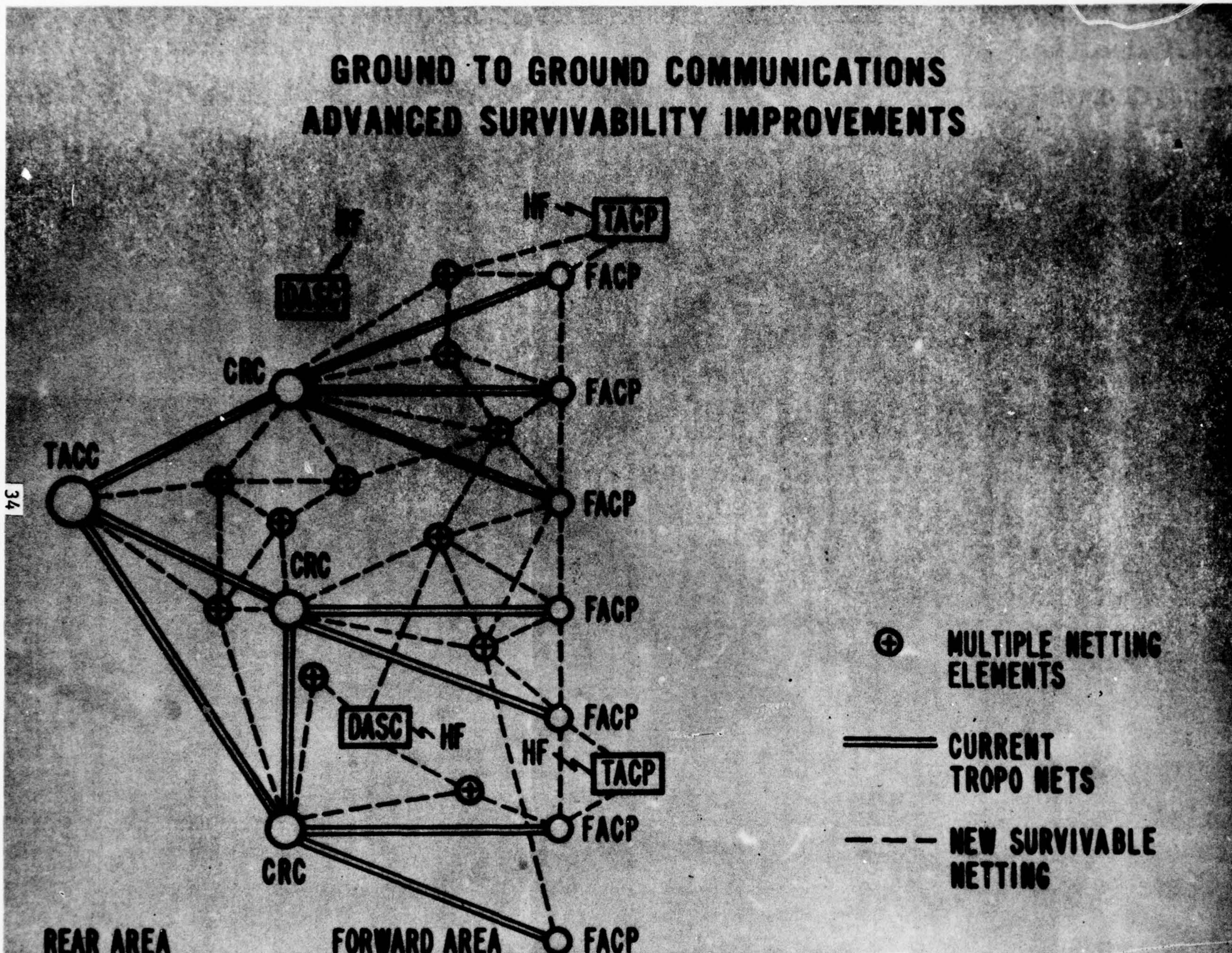

FIG. 14 GROUND TO GROUND COMMUNICATIONS ADVANCED SURVIVABILITY IMPROVEMENTS

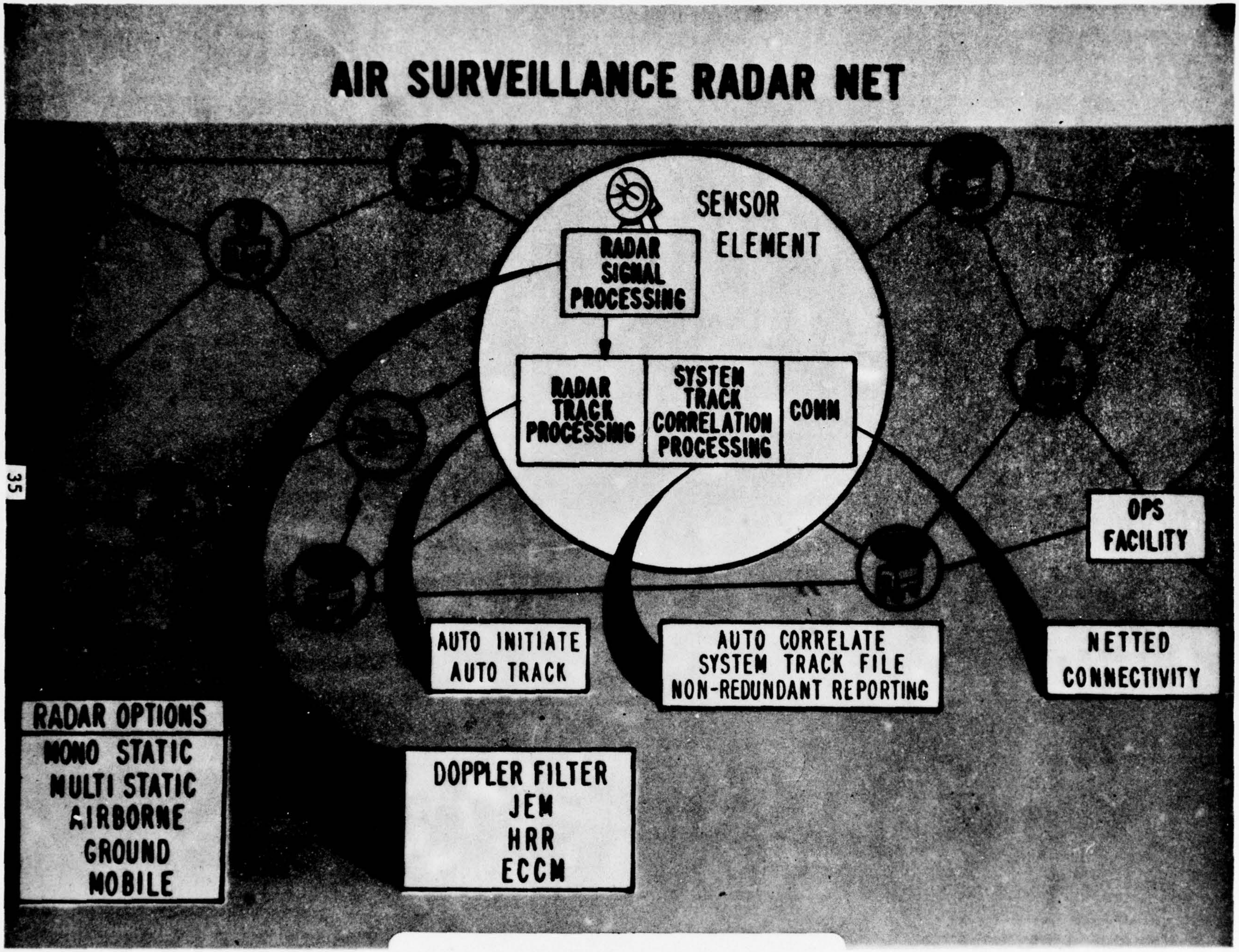

FIG. 15 AIR SURVEILLANCE
RADAR NET

FIG. 16 MOBILE RADAR COMMUNICATIONS EQUIPMENT

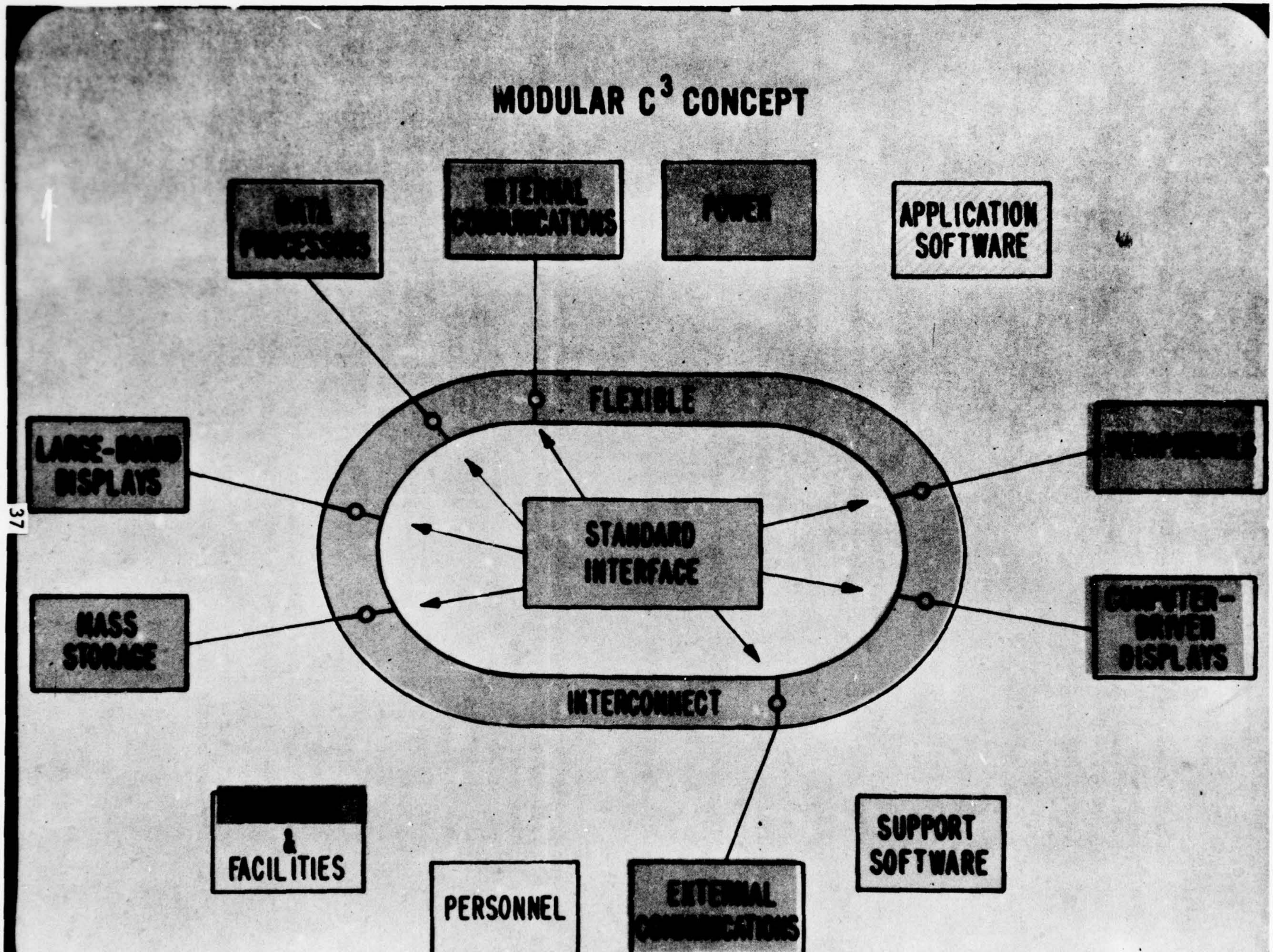

FIG. 17 MODULAR C^3 CONCEPT

the unique suite for particular centers, all centers would be generally identical and, only a limited number of 'exceptional' modules would be one-of-a-kind. Many other benefits occur - too long to be discussed here. Fibre optics technology is being pushed for bus implementation.

(3) Fibre Optics
Figure 18 shows one of the advantages of fibre optics. The fibre optic reel contains 1000 feet of fibre with a much wider bandwidth than the 200 feet of copper in the big reel. Figure 19 summarizes fibre optics' advantages, development needs, and Air Force applications made to date.

(4) Correlation and Fusion
Figure 20 shows the process desired, i.e. (1) information is collected, (2) it is assembled into the location and identification of enemy units, (3) it is placed in geographical reference coordinates, and (4) it is displayed to a decision maker along with friendly order-of-battle information on a convenient display.

The aggregation and correlation process is multi-step, Figure 21, e.g. the data are collected are associated with their sources, e.g. radar type; these arrays of sources are identified as units, units are identified and arrayed into divisions, divisions into armies, etc.

(5) Decision Aids
A major objective of present work on decision aids is to develop techniques for presenting data to decision makers in forms which they readily comprehend and which react to their individual requirements. It is important to develop techniques for providing the user with the data he needs, separate this from what data and displays he might like or he might be arbitrarily given, make sure to give him what he needs in the form he needs it, and reserve the extraneous information for optional call-up. A typical display which resulted from the process described in (4) above is shown in Figure 22, where the commander is presented with only the information he needs in the form he needs it. In the north are designated targets (B is a bridge, M is a missile, A is an airfield, E is an early warning site. A also indicates assigned, U indicates unassigned). In the south are indicated airbases having the resources to strike those targets. The dotted lines are computer-suggested assignments of air strike assets to the targets. They are not flight paths. Flight paths are independently calculated.

ELECTRONIC SYSTEMS DIVISION

FIBER OPTICS - ADVANTAGES, NEEDS, APPLICATIONS

ADVANTAGES:

- WEIGHT, SIZE, AND POTENTIAL SYSTEM COST SAVINGS
- ELIMINATE GROUND LOOPS, LIGHTNING, AND EMP THREATS
- NEGLIGIBLE CROSSTALK, NO EMISSIONS OR PICKUP, ADDED SECURITY, MINIMIZE ARM THREAT
- CAPACITY/BANDWIDTH - 45 MBS (700 VOICE CHANNELS)
- LINK LENGTH - REPEATERLESS TO 5 MILES
- DEPLOYMENT FLEXIBILITY

NEEDS:

- CONNECTORS: MULTICONDUCTOR, EASIER TO CONNECT, FIELD MAINTAINABLE, LOW LOSS
- SOURCES: IMPROVED LASERS, DRIVERS, LED'S
- DETECTORS: INCREASED SENSITIVITY

APPLICATIONS:

- RADAR REMOTING LINK
- C^3 CENTER INTRACONNECT
- SECURE APPLICATIONS

FIG. 18 FIBER OPTICS - ADVANTAGES, NEEDS, APPLICATIONS

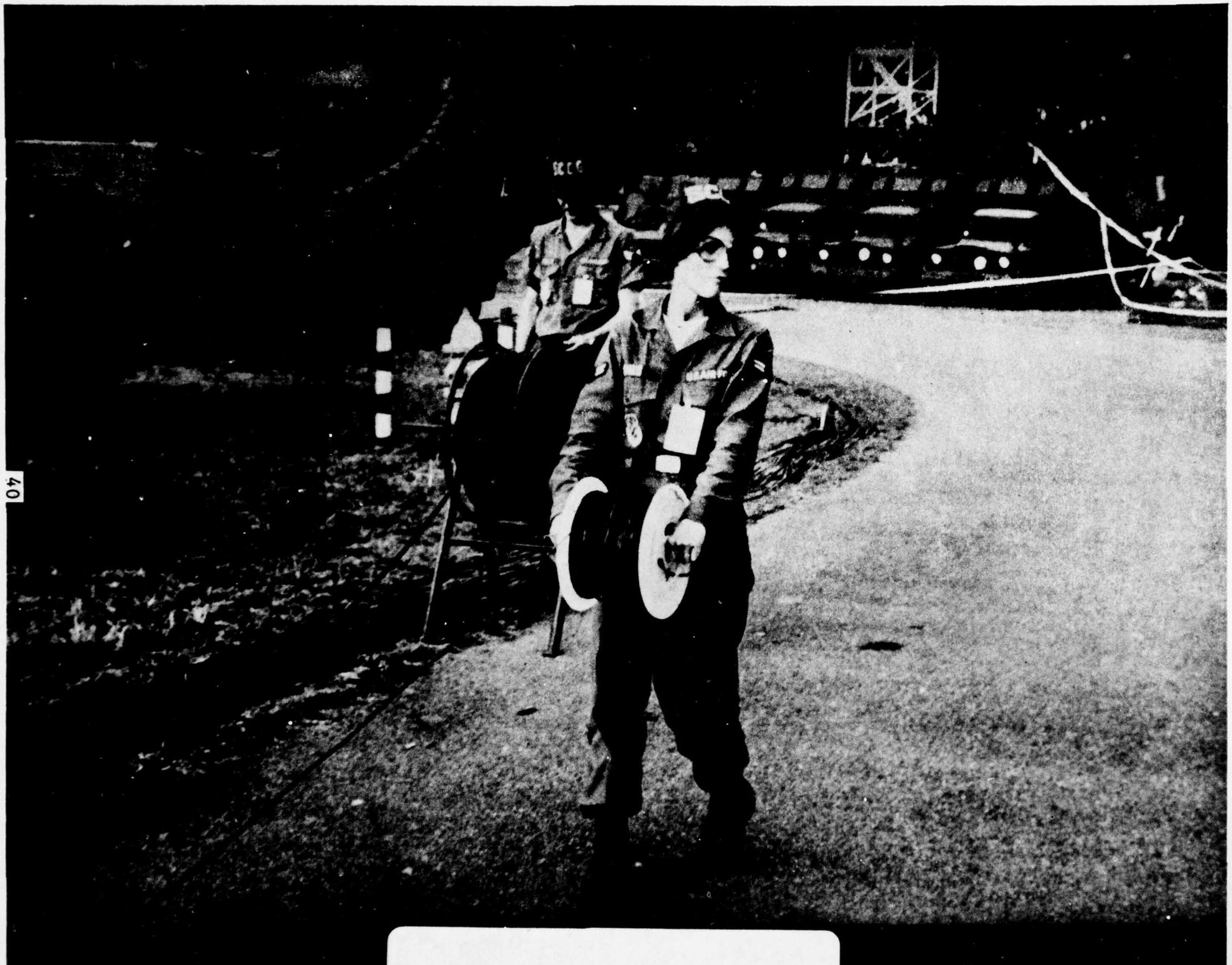

FIG. 19 PICTURE OF FIBRE OPTICS

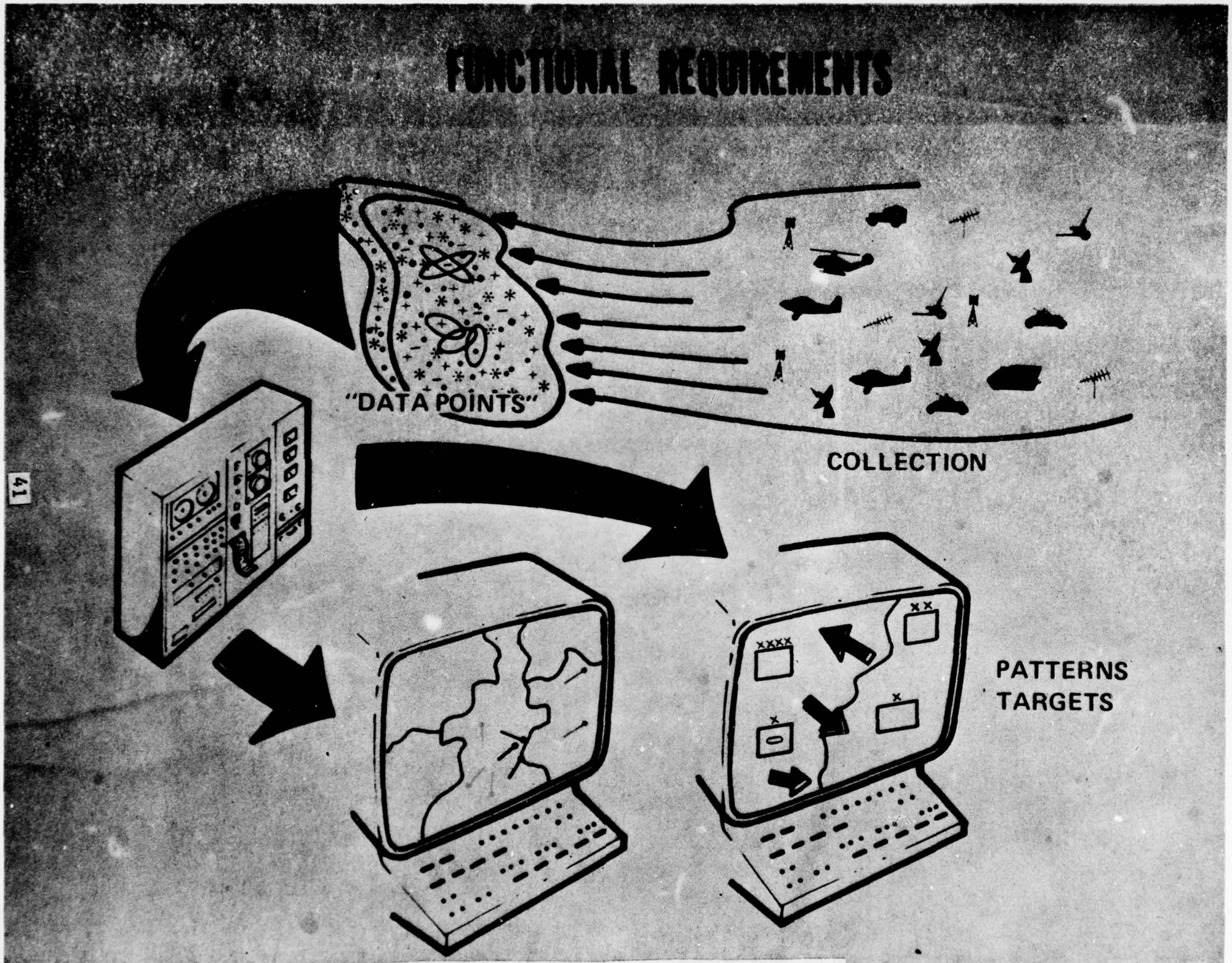

FIG. 20 FUNCTIONAL REQUIREMENTS

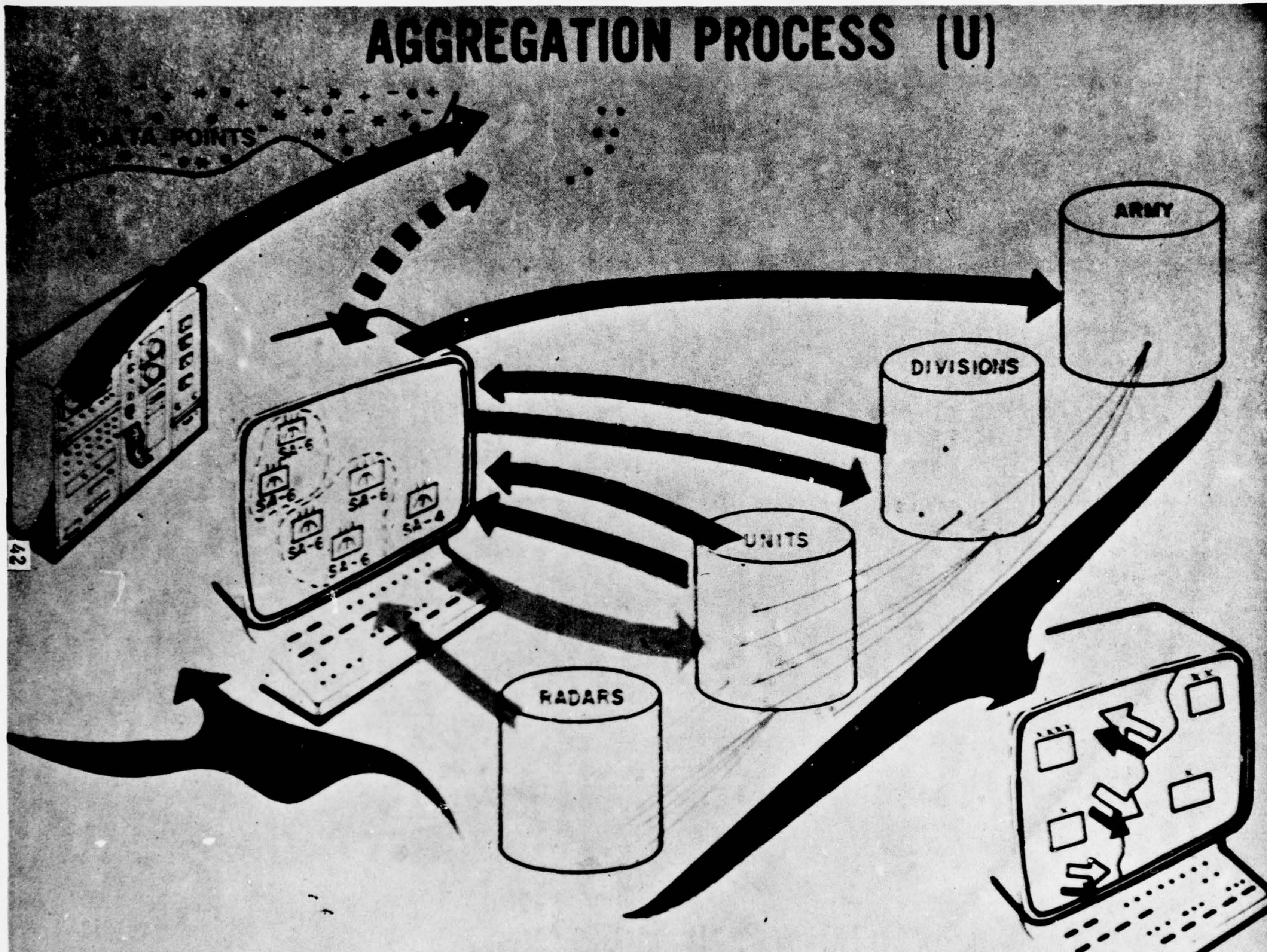

FIG. 21 AGGREGATION PROCESS

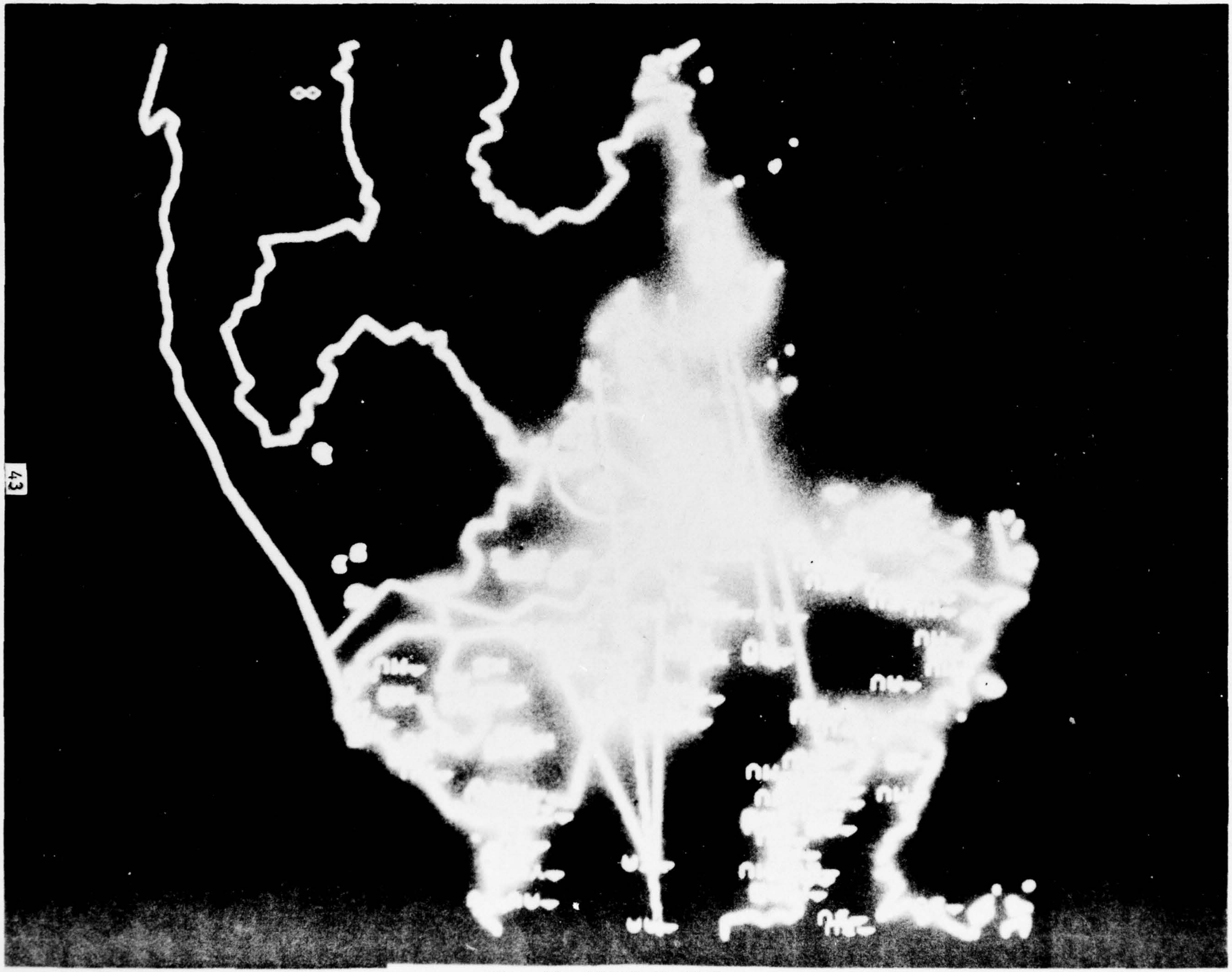

FIG. 22 DECISION AIDS

SECTION VII

CONCLUDING REMARKS

The development of C^3I systems have, at least for the past twenty plus years, been intimately related to the development of the computer and related signal and communication processing electronics. These, in turn, have been governed by the development of semi-conductor devices. Today we are at the point where complete microprocessor central processors are available on a single 1/4 inch chip as shown in Figure 23 and at costs less than $10. In the near future, complete computers will be available on the same size chips.

We have been quite correct in saying that nowadays, we can do anything we want to do and wherever we want to do it. Our problem is to decide what we want to do. With regard to Tactical C^3I, the technology does exist to do anything we want to do, DoD's problem is to incentivize industry to apply the technology to satisfy DoD's needs. This is made obvious by Figure 24 which shows how the government market is a declining share of the total U.S. electronics market. (What was true up to 1974 is even more true today.) The purpose of the new DoD-initiated Very High Speed Integrated (VHSI) Circuit initiative is to assure a nitch in the industry for a DoD-dominated and DoD-driven technology; one in which the commercial market has 'no' incentive. Thus, in the near future, it can be expected that electronic hardware will not be a bottleneck for tactical C^3I. Until present research initiatives payoff, software <u>will</u> remain a bottleneck. In time that will be solved.

The TAF C^3I community can, therefore, look forward to the day when the technology will be available to develop almost any capability desired; the question is what is needed. This is where the architectural and planning efforts of the type recently initiated, as described earlier, will pay off. The key to the future of Tactical C^3I is architectural planning, the lock to be opened by the key is provided by technology.

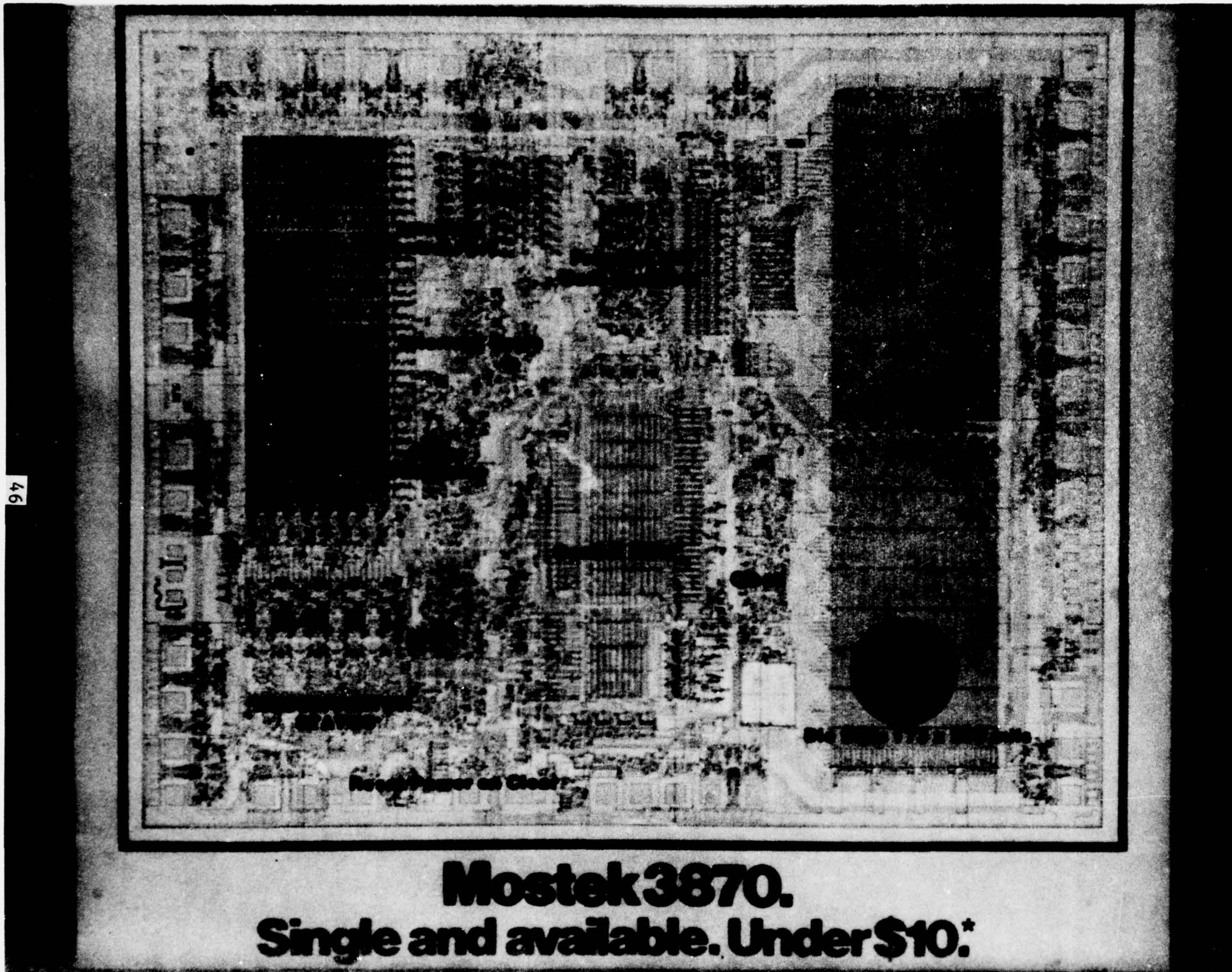

FIG. 23 MOSTEK 3870

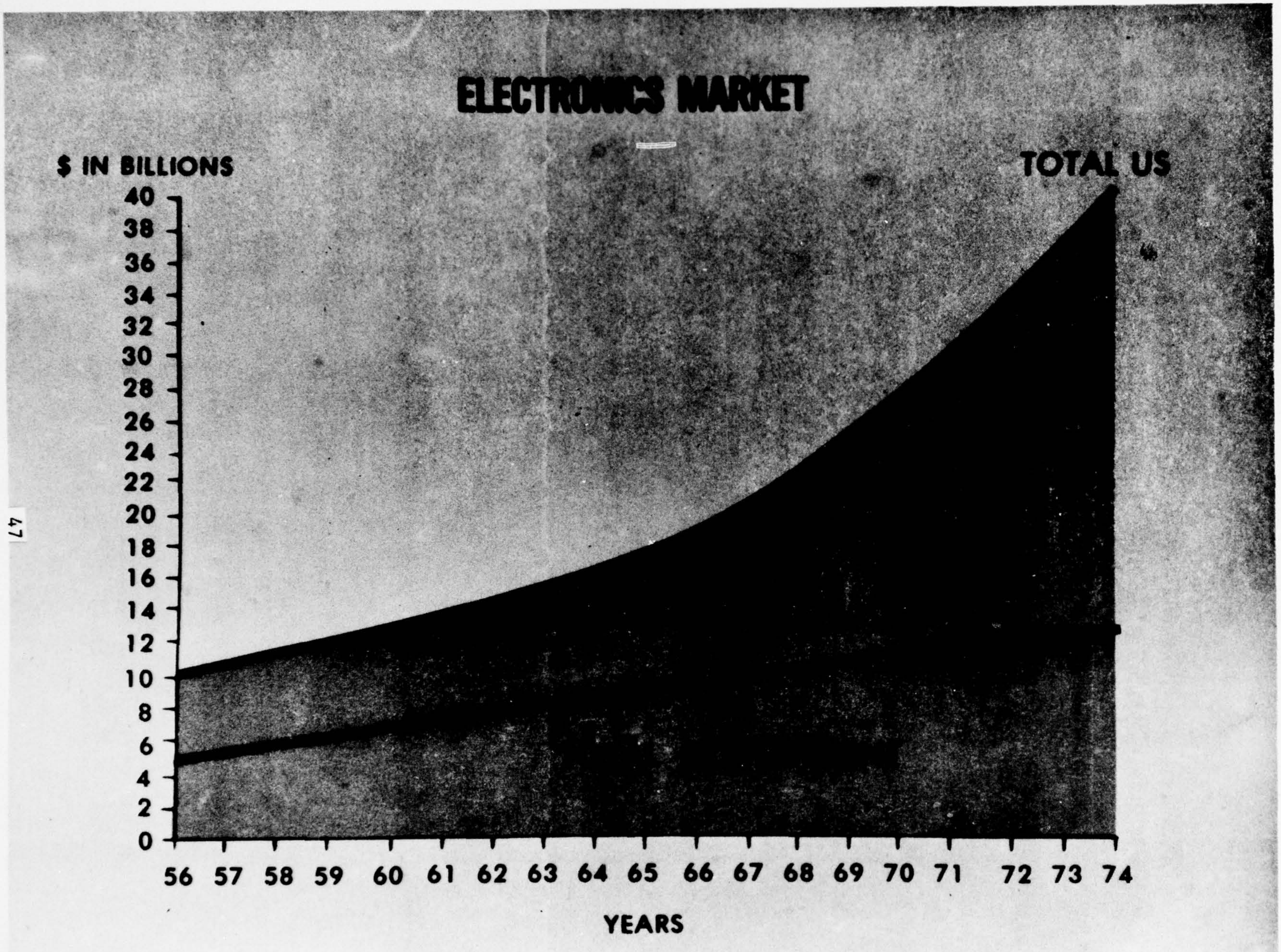

FIG. 24 ELECTRONICS MARKET

SECTION VIII

DISCUSSANT REMARKS

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Developments in modular C^3 applications have made it not only possible, but also highly desirable to restructure the TACS to capitalize on technological advances. Equipment commonalities achieved through modules will allow COMAFFOR great flexibility in deploying and employing the TACS.

This means that a "Control Center Package" rather than a Control Reporting Center/Post or Forward Air Control Post will become a viable concept. With this CCP, a force tailored to the exact mission can be used. In one scenario it may mean two modules for airspace control, and one module each for battle management, air surveillance and identification. Involvement in a larger theater could require dispersed CCPs with a mix of management, control, surveillance and identification functions as determined by the present situation. In a fluid environment, assets could easily be shifted from control to identification, etc., as needed.

As a fall out of this concept, the present TACS acronyms would disappear and be supplanted with functional modules. Besides the obvious optimum employment and versatility advantages gained by deleting per se "CRC/CRP/FACP's," another benefit of interoperability through decreased confusion would be achieved. The functional modular concept would ease operating with allies. Presently these joint endeavors are unnecessarily complicated because of misunderstanding in military acronyms, "DASC vs. ASOC", SOC, ATOC vs. TACC" etc. These conceptual differences can be swept aside with Control Center Packages.

The continuing advances made in modular command, control and communications will provide direct improvements as outlined above and lead to residual benefits by assisting in meeting numerous other TAFIIS architectural area goal capabilities.